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Emission of Soil Dust Aerosol: Anthropogenic Contribution and Future Changes

Ina Tegen, MPI for Biogeochemistry, Jena, Germany (ITEGEN@BGC-JENA.MPG.DE)

S.P. Harrison, MPI for Biogeochemistry, Jena, Germany (SHARRIS@BGC-JENA.MPG.DE)

K.E. Kohfeld, MPI for Biogeochemistry, Jena, Germany (KEK@BGC-JENA.MPG.DE)

S. Engelstaedter, MPI for Biogeochemistry, Jena, Germany (SENGEL@BGC-JENA.MPG.DE)

M.Werner, MPI for Biogeochemistry, Jena, Germany (MWERNER@BGC-JENA.MPG.DE)

Introduction

Soil dust aerosol is an important factor in the climate system, impacting on the radiation balance, atmospheric chemistry and biogeochemical cycles. Anthropogenic disturbance of soil surfaces has been estimated to contribute as much as 50% to the modern global dust load in the atmosphere (Intergovernmental Panel on Climate Change 2001), but this estimate is highly uncertain. We need to quantify this contribution more accurately in order to understand the historical dust record and estimate future changes in dust emissions.

Method

We compare a global compilation of dust storm frequencies, based on data from more than 2000 stations, to vegetation cover and the distribution of cultivated and rangeland areas. The global emission of natural and anthropogenic dust is computed with a dust source model, which explicitly includes the contribution of preferential source areas and vegetation phenology.

Results and Discussion

We find only slightly higher dust storm frequencies in rangeland and cropland areas than in undisturbed regions (Figure 1). The increase is small, and, according to our model anthropogenically-disturbed soils contribute only 5 to 15% to the modern global dust emission. Using these results, we estimate the role of future changes in anthropogenic dust loading in offsetting natural changes in dust emissions under a global warming scenario. First results indicate that the change in natural emissions under a global warming scenario for 2050 is small in the global mean (ca. 10% decrease in dust emissions), but regional effects (e.g. in east Asia) may be considerable.

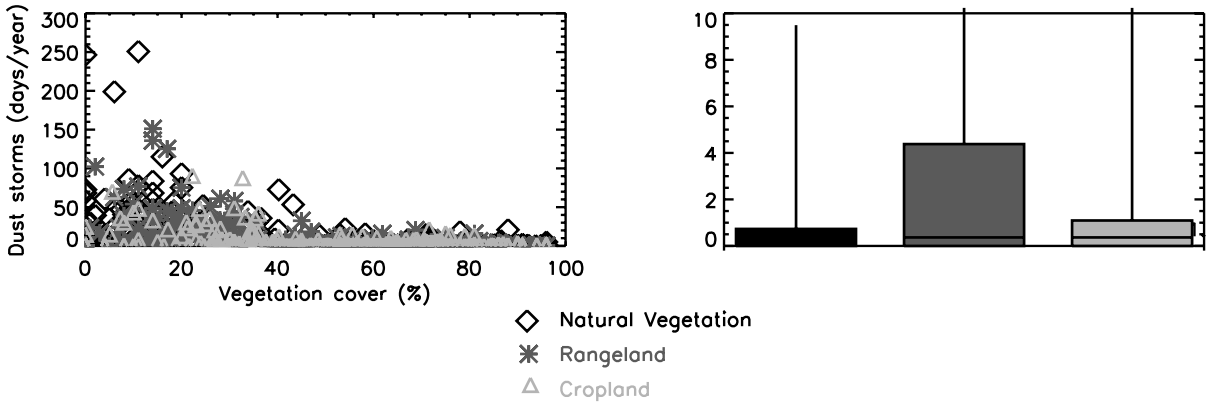

Figure 1: Comparison of global dust storm frequencies in areas of natural vegetation, croplands and rangelands. The relationship between dust storm frequencies and vegetation cover (left) shows that maximum dust storm frequencies in cultivated areas do not exceed those in natural areas. The bars (right panel) indicate the 25th to 75th percentiles of the data.

References

Intergovernmental Panel on Climate Change. 2001. Climate Change 2001. Edited by J. T. Houghton et al.. Cambridge University Press, New York.